SEMESTER EXAMINATION, DECEMBER, 2025

Course Name: - B.Tech. (ECE) **Semester:- III**

Paper Name: - Digital System Design **Paper Code:- NEC 301**

Time - 3 Hrs + 20 minutes per hour extra time for V.I. & examinees with writer. **Max Marks-70**

Instructions:

- The question paper consists of three sections namely A, B, C. All sections are compulsory.
- Section A- Each question carries **3 mark. All questions are compulsory**.
- Section B- Answer any **5 out of 7** given questions. Each question carries **7 marks**.
- Section C- Answer any **2 out of 3** given questions. Each question carries **10 marks**.

Section – A (खण्ड–अ)

Multiple Choice Questions (बहुविकल्पीय प्रश्न)

1. Answer all the following questions. 5x3 =15
निम्नलिखित सभी प्रश्न अनिवार्य हैं।

i) The expression $\overline{AB(C+D)}$ is equal .....using De Morgan's theorem.

a) $\bar{A}+\bar{B}+\overline{CD}$
b) $\bar{A}+\bar{B}+\bar{C}\bar{D}$
c) $\bar{A}\bar{B}+\bar{C}\bar{D}$
d) $\bar{A}\bar{B}+\overline{CD}$

ii) What is the primary purpose of the Gajski-Kuhn Y-chart in digital system design?

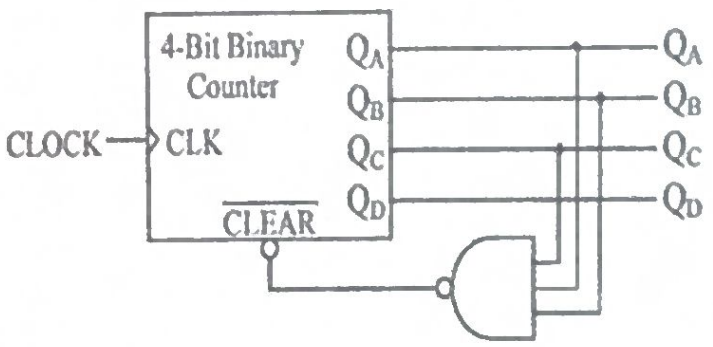
a) To visualize the temporal behaviour of a system.
b) To map out the control flow of a software algorithm.
c) To depict the data flow and control flow of a hardware design.
d) To represent the hierarchical structure of a software system.

iii) Which one of the following is not correct?

a) $\bar{P}\oplus Q = P\oplus Q$
b) $\overline{P\oplus Q} = P\odot Q$
c) $\bar{P}\oplus Q = P\odot Q$
d) $(P\oplus\bar{P})\oplus Q = (P\odot\bar{P})\odot\bar{Q}$

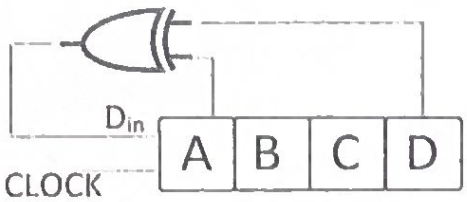
iv) A mod-n counter using asynchronous binary up-counter with synchronous clear input is shown in the figure where Q_A is MSB bit and Q_D is LSB bit. The value of n is

a) 13
b) 12
c) 7
d) 14



v) A 4-It shift register circuit configured for right shift operation, i.e. $D_{in}\rightarrow A$, $A\rightarrow B$, $B\rightarrow C$, $C\rightarrow D$, is shown. If the present state of the shift register is ABCD=1001, the number of clock cycles required to reach the state ABCD=1111 is _____.

a) 6
b) 7
c) 8
d) 10



Section – B (खण्ड–ब)
Short Answer Questions (लघुउत्तरीय प्रश्न)

2. Answer any five of the following questions. **5x7=35**
निम्नलिखित में से किन्हीं पाँच प्रश्नों के उत्तर दें।

i. What is M-Notation in Boolean Algebra? Explain it. Convert the following equation into standard POS form.

Y= $\overline{(AB + A\bar{C})}\ (B + C)$

ii. Using K – map, obtain the minimal POS expressions of the following and design output of K-Map by basic logic gates.

$$F(A,B,C,D) = \sum m(4,6,7,9.10,)\ +\ D(0,5,13)$$

iii. What is magnitude comparator? Design and explain a two bit comparator using logic gates.

iv. What is characteristics table and excitation table in the context of flip-flops? Design S-R Flip Flop from J-K flip flop.

v. What are the digital logic families? Explain its characteristics and importance?

vi. What is multiplexer? Implement the following Boolean expression using 8:1 multiplexer.

$$F(A,B,C,D) = BCD + ACD + \bar{A}B\bar{D}$$

vii. Describe logic gates and their symbols. Explain universal gates and show how other gates can be implemented using NAND gates only.

Section – C (खण्ड–स)
Descriptive Questions (विवरणात्मक प्रश्न)

3. Answer any two of the following question. **2x10=20**
निम्नलिखित में से किन्हीं दो प्रश्नों के उत्तर दें।

i) What are combinational and sequential circuits, and how do they differ? Design a combinational circuit that adds one to a 4-bit binary number $A_3A_2A_1A_0$. The circuit can be designed being four half adder.

ii) Compare the synchronous sequential circuit and asynchronous sequential circuit. Also design a synchronous sequential circuit for the following sequence by J-K flip flop:

2-3-0-6-1-5-2-3-0-6-1.....

iii) Explain Boolean Algebra. State and prove important Boolean laws and theorems. Discuss their role in logic simplification.

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